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Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

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Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

R C van Dijk

DEN HAAG, DEN
THE HAGUE,
LA HAYE, LE 25/11/02

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Sheet 2 of the certificate
Page 2 de l'attestation

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Display with dummy edge electrode

The present invention relates to an electroluminescent device and a display device comprising a first and a second layer of conductive electrodes and an active layer comprising electroluminescent material, said active layer being located between said first and second layers, said electrodes being arranged for connection to respective electric control means and thereby defining an active area of the display.

Electroluminescent displays according to prior art comprise two flat layers of elongated and parallel conductive electrodes, i.e. an anode layer and a cathode layer. The electrodes are usually arranged to form a matrix of picture elements (pixels) for use in a matrix display device. Commonly, the direction of elongation of the anodes is perpendicular to the direction of elongation of the cathodes, and pixels are formed at the crossing of an anode and a cathode. The electrode layers are produced by way of techniques known in the art, such as sputtering, evaporation and lithographic techniques.

Between the electrode layers is an organic electroluminescent layer located. Preferably, said organic electroluminescent layer comprises an electroluminescent polymer material. The polymer layer is produced, e.g., by way of known spin coating techniques or produced by way of an ink-jet printing method. Electric control means drives the electrodes such that potential differences between anodes and cathodes results in electroluminescence in the organic electroluminescent layer.

A specific prior art device is disclosed in the Japanese patent application having publication number 2000-012238. An organic electroluminescent matrix element comprises a number of elongated parallel electrodes. The voltage of each electrode is controlled such that a desired electroluminescence is obtained in an electroluminescent layer adjacent to the electrodes. A dummy electrode is located at the edge of the parallel electrodes. The voltage of the dummy electrode is controlled such that a reverse, with respect to an adjacent edge electrode, voltage is always present. Due to the reverse voltage, no electroluminescence is obtained via the dummy electrode.

It has been noted that during a time-period which is significantly less than the lifetime of such a matrix display device, the light output of the pixels at the edge of the display will decrease.

An object of the invention is to overcome the drawbacks related to prior art devices as discussed above. This object is achieved in an inventive manner by a device as claimed in the appended claims.

According to a first aspect, the invention relates to an electroluminescent device comprising a first and a second layer of conductive electrodes and an active layer comprising electroluminescent material, said active layer being located between said first and second layers, said electrodes being arranged for connection to respective electric control means and thereby defining an active area of the device. The first electrode layer further comprises at least one dummy electrode, said dummy electrode being arranged to be unconnected with respect to said electric control means and located at least partly along an outer edge of said active area.

An effect of the invention is that it counteracts the negative effects that produces the problem of reduced lifetime of a display as discussed above. The negative effects are due to an increased potential drop across the electrode located at the edge of the active area. The potential drop leads to a decrease in potential difference across the electroluminescent layer resulting in a decreased light output from the electroluminescent material between the cathode and anode layers.

The potential drop across the electrode is probably due to an increased internal resistance caused by electrochemical oxidation of the material in the electrode. It can be noted that the rate of electrochemical oxidation of the edge electrode is depending on the strength of the lateral (perpendicular to the direction of elongation of the electrode) electric field present at the edge.

Hence, in order to reduce the strength of such a lateral electric field at the edge electrode, a dummy electrode is arranged along the edge of the active area of the display. The dummy electrode is unconnected with respect to the electric control means that control the voltage of the electrodes of the active area of the display. The unconnected state of the dummy electrode results in a situation where the dummy electrode attains, by way of the lateral electric field produced by neighboring electrodes, a varying electric potential, i.e. a floating potential. This leads to a reduction in the strength of the lateral electric field between

the dummy electrode and the adjacent electrodes of the active area and thereby alleviating the negative effects of electrochemical oxidation of the electrodes at the edge of the active area.

An advantage of the present invention is that it increases the lifetime of an electroluminescent display device. That is, the deterioration rate of the anode electrodes at the edge of the active area becomes comparable to the deterioration rate of the anode electrodes within the active area, hence leading to an even light output across the active area.

In an embodiment of the invention, the dummy electrode is totally unconnected with respect to any conductor, thereby providing an advantage of being very simple to manufacture.

Although the invention as stated above is directed to a device of any geometrical shape, a preferred embodiment is that of a matrix configuration and also that the dummy electrode is of the same shape and geometrical extent as the electrodes of the active area.

Such an embodiment also has the advantage of being simple to, for example, a smaller shape for reasons of space reduction. A smaller shaped dummy electrode has the advantage of a smaller passive area (and thus smaller device) than the dummy electrode of the same shape.

Moreover, by suitably selecting a polymer material such as polyethylenedioxythiophene as a constituent part of the material of the electrodes, an efficient electroluminescence can be obtained.

According to a second aspect of the present invention a display device is provided. The display device comprises a substrate layer on which a first and a second layer of conductive electrodes and an active layer comprising electroluminescent material are arranged, said active layer being located between said first and second layers, said electrodes being connected to electric control means and thereby defining an active area of the display. The first electrode layer further comprises at least one dummy electrode, said dummy electrode being unconnected with respect to said electric control means and located at least partly along an outer edge of said active area.

The technical effects and advantages of such a device has been discussed with respect to the electroluminescent device above.

The invention will now be described in terms of preferred embodiments and reference will be made to the drawings, where:

Figure 1 shows schematically a perspective view of an electroluminescent device according to the invention, and

Figure 2 shows schematically a diagram of a display device according to the invention.

Figure 1 illustrates schematically an embodiment of an electroluminescent device according to the invention. The device comprises a substrate 101, which may be of any material known in the art including glass materials and appropriately chosen by the skilled person. On the substrate 101 are a number of parallel anode electrodes 102 located, i.e. an anode electrode layer. Although only a few are illustrated in Figure 1, the skilled person realizes that the number of anode electrodes 102 may be much greater and counted in hundreds, if not thousands. Moreover, the anode electrodes 102 are produced by way of techniques known to the skilled person, such as sputtering, evaporation and lithographical techniques and may consist at least partly of a polymer material, e.g. polyethylenedioxythiophene.

The anode electrodes 102 are all connected to an anode control unit 106 which provides electric voltages to the anode electrodes 102, as the skilled person realizes.

On the anode electrodes 102 is an electroluminescent layer 105 located. The electroluminescent layer 105 is manufactured in a manner known to the skilled person and is, for example, of an appropriately chosen polymer material.

On the electroluminescent layer 105 are a number of parallel cathode electrodes 104 located. As for the anode electrodes 102 discussed above, only a few are illustrated in Figure 1 and the skilled person realizes that the number may be much greater. Moreover, the cathode electrodes 104 are also produced by way of techniques known to the skilled person, such as sputtering, evaporation and lithographical techniques.

The cathode electrodes 104 are all connected to a cathode control unit 107 which provides electric voltages to the cathode electrodes 104, as the skilled person realizes and in combination with the anode control unit 106 drives the electrodes such that potential differences between anode electrodes and cathode electrodes results in electroluminescence in the electroluminescent layer 105.

The layer comprising anode electrodes 102 further comprises two dummy anode electrodes 103, that are unconnected to the anode electrode control unit 106. These dummy anode electrodes 103 are located adjacent to the anode electrodes 102.

The effect of these unconnected dummy anode electrodes 103 is that their presence counteract the negative effects that produces the problem of reduced lifetime of a display as discussed above. The negative effects are due to a strong lateral electric field at the edge anode electrodes 102 located adjacent to the dummy anode electrodes 103. Without the presence of the dummy anode electrode 103, the strong lateral electric field would lead to an increased deterioration rate and hence a decrease in potential difference across the electroluminescent layer 105 resulting in a decreased light output, as already discussed above.

In Figure 2 a second embodiment of the present invention is schematically shown. A display unit 201 is shown, which is suitable for use in a computer, mobile communication terminal or indeed in any electronic equipment that require a display screen. For simplicity, the equipment to which the display unit 201 is connected, is in Figure 2 illustrated as a generic user unit 208.

The display unit comprises an electroluminescent device as described above in connection with Figure 1. That is, a device on a substrate 202, in which an electroluminescent layer 206 is located between layers of anode electrodes 203 and cathode electrodes 205. A control unit 207 controls, in cooperation with the user equipment 208, the voltages applied to the anode electrodes 203 and the cathode electrodes 205 in such a manner that an active area 209 is obtained.

The layer comprising anode electrodes 203 further comprises two dummy anode electrodes 204 that are unconnected to the control unit 207. These dummy anode electrodes 204 are located adjacent to the anode electrodes 203 at the edges of the active area 209, resulting in the effect that the lifetime of the anode electrodes 203 at the edge of the active area 209 is increased.

Finally, in summary, it has been described an electroluminescent display device, comprising layers of anode electrodes, cathode electrodes and an electroluminescent layer, a dummy electrode is arranged along the edge of the anode electrode layer. The dummy electrode is unconnected with respect to the electric control means that control the voltage of the electrodes of the active area of the display. The unconnected state of the dummy electrode results in a situation where the dummy electrode attains, by way of the lateral electric field produced by neighboring electrodes, a floating electric potential. This leads to a reduction in the strength of the lateral electric field between the dummy electrode and the adjacent electrodes and thereby alleviating the negative effects of electrochemical oxidation of the electrodes at the edge of the active area.

CLAIMS:

1. Electroluminescent device comprising a first and a second layer of conductive electrodes (102,104,203,205) and an active layer comprising electroluminescent material (105,206), said active layer being located between said first and second layers, said electrodes being arranged for connection to respective electric control means (106,107,207) and thereby defining an active area (209) of the device, characterized in that the first electrode layer further comprises at least one dummy electrode (103,204), said dummy electrode being arranged to be unconnected with respect to said electric control means and located at least partly along an outer edge of said active area.

2. Electroluminescent device according to claim 1, said at least one dummy electrode being arranged to be unconnected with respect to any conductor.

3. Electroluminescent device according to any one of claims 1-2, said electrodes of the first layer being elongated and substantially parallel, said electrodes of the second layer being elongated and substantially parallel, said electrodes of the first layer being substantially perpendicular to the electrodes of the second layer, thereby defining a matrix display, and said at least one dummy electrode being elongated and substantially parallel to the electrodes of the first layer.

4. Electroluminescent device according to claim 3, said dummy electrode being substantially of equal spatial extent as the electrodes of the first layer.

5. Electroluminescent device according to any one of claims 1-4, said electrodes of the first layer comprising polyethylenedioxythiophene.

6. Display device (201) comprising a substrate layer (202) on which a first and a second layer of conductive electrodes (203,205) and an active layer comprising electroluminescent material (206) are arranged, said active layer being located between said first and second layers, said electrodes being connected to electric control means (207) and

thereby defining an active area (209) of the display, characterized in that the first electrode layer further comprises at least one dummy electrode (204), said dummy electrode being unconnected with respect to said electric control means and located at least partly along an outer edge of said active area.

ABSTRACT:

In an electroluminescent display device, comprising layers of anode electrodes (102), cathode electrodes (104) and an electroluminescent layer (105), a dummy electrode (103) is arranged along the edge of the anode electrode layer. The dummy electrode is unconnected with respect to the electric control means (106,107) that control the voltage of the electrodes of the active area of the display. The unconnected state of the dummy electrode results in a situation where the dummy electrode attains, by way of the lateral electric field produced by neighboring electrodes, a floating electric potential. This leads to a reduction in the strength of the lateral electric field between the dummy electrode and the adjacent electrodes and thereby alleviating the negative effects of electrochemical oxidation of the electrodes at the edge of the active area.

Fig. 1

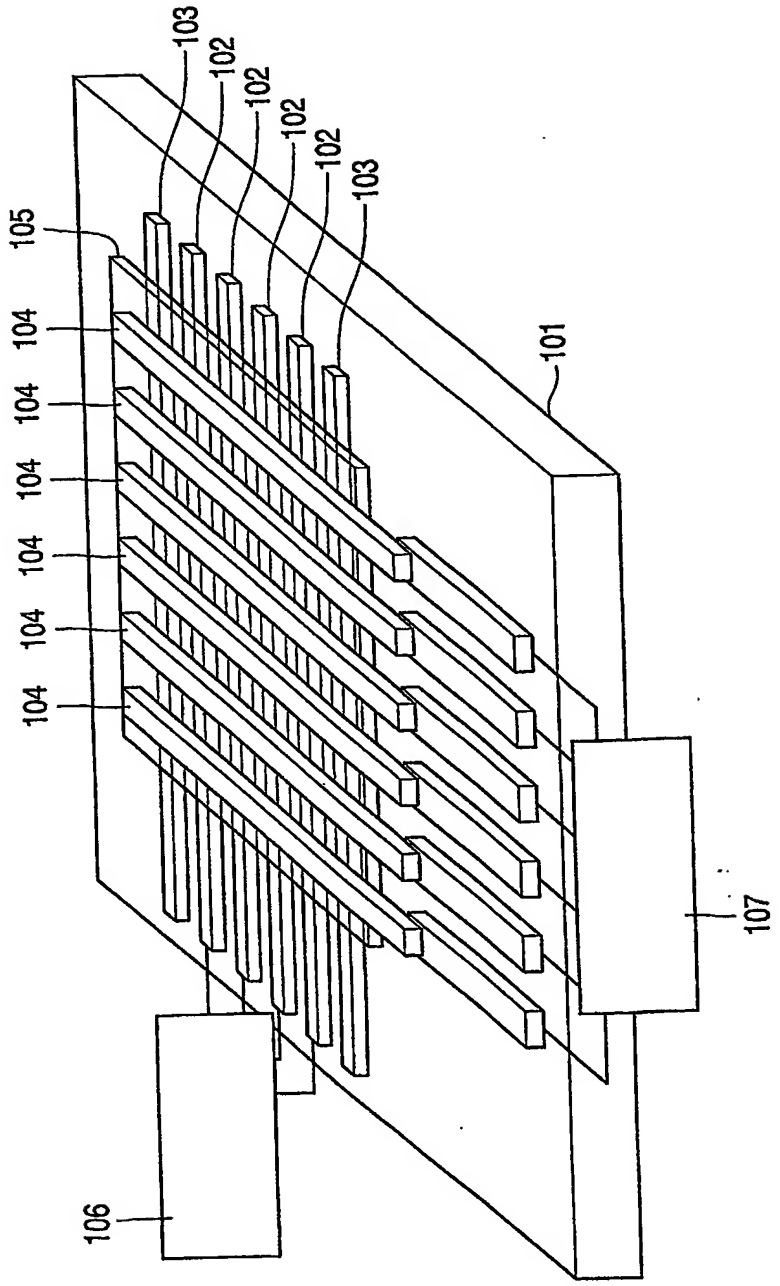

FIG. 1

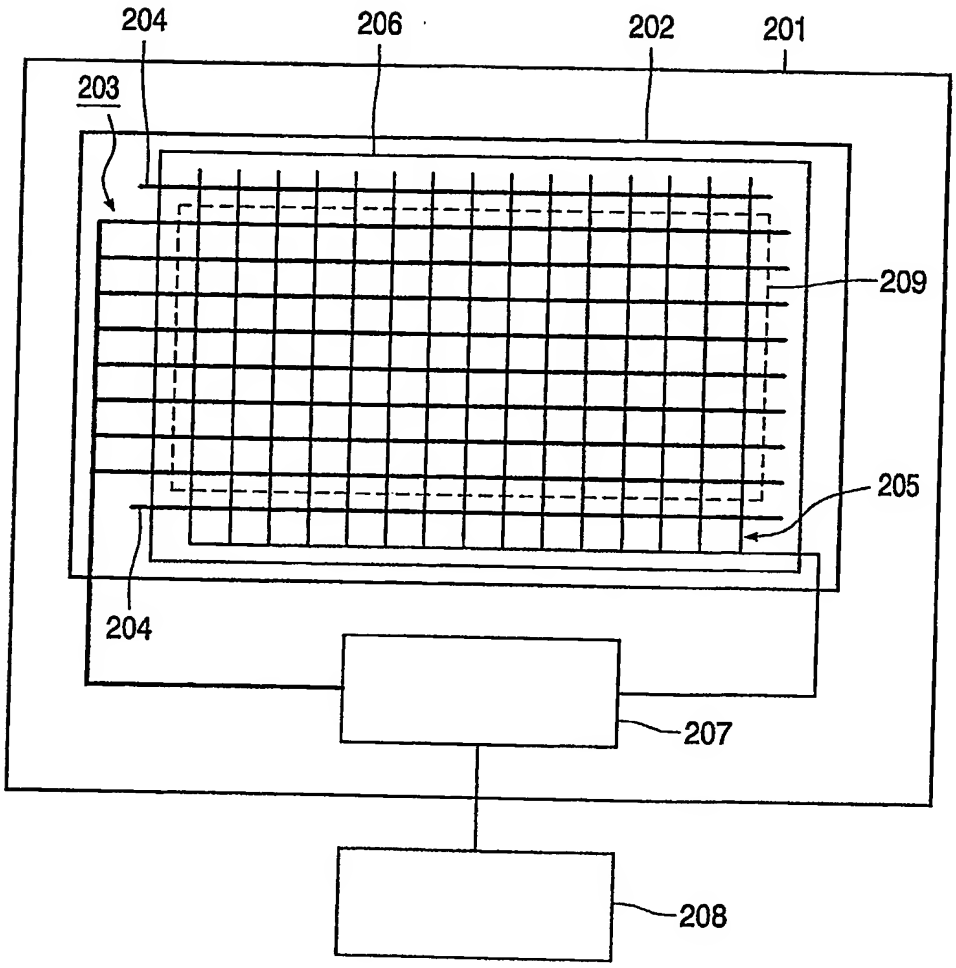

FIG. 2